

AMENDMENTS TO THE CLAIMS

Please amend Claims 1-27 and 29, cancel Claim 28, and add new Claims 30-32.

1. (Currently Amended) A method of determining tissue densities from computed tomography (CT) images, the images containing voxel representations of x-ray attenuation of a subject's body, the method comprising:

acquiring at least one CT image of the subject's body and a calibration phantom simultaneously;

determining a CT attenuation measure of at least one region of the phantom;

locating a region of the image containing representing the subject's blood or heart tissue;

determining a CT attenuation measure of the ~~at least one~~ region located ~~within~~ representing blood or heart tissue;

combining the CT measure of the phantom and the CT measure of the blood or heart tissue to develop a calibration relationship;

applying the calibration relationship to ~~the~~ an image of the subject's body;

and

recording a calibrated image.

2. (Currently Amended) The method of Claim 1, wherein the CT attenuation measure of the region representing blood or heart tissue is the mode of ~~the~~ a histogram of the CT numbers representing x-ray attenuation of the region.

3. (Currently Amended) The method of Claim 1, wherein the CT attenuation measure of the region representing blood or heart tissue is ~~the~~ a mean of ~~the~~ CT numbers representing x-ray attenuation of the region.

4. (Currently Amended) The method of Claim 1, wherein the calibration relationship is a regression equation.

5. (Currently Amended) The method of Claim 1, wherein the calibrated image contains representations of voxels expressed in density units.

6. (Currently Amended) A method to calibrate ~~the~~ a computed tomography (CT) density of a tissues in x-ray computed tomography, the method comprising:

acquiring at least one image containing voxels representing x-ray attenuation in the tissue, ~~the method comprising~~;

locating a measurement region in at least one area of the image ~~containing~~ representing blood;

~~recording the~~ determining a measured CT numbers representing x-ray attenuation of the region;

determining a reference CT number representing x-ray attenuation of blood; and

correcting the at least one image by ~~the~~ a relationship between the reference CT number and the measured CT number of ~~blood~~ the region.

7. (Currently Amended) The method of Claim 6, wherein the tissue is coronary calcium.

8. (Currently Amended) The method of Claim 6, wherein the tissue is lung.

9. (Currently Amended) The method of Claim 6, wherein the reference CT number of blood is measured in vitro.

10. (Currently Amended) A method of determining a coronary calcium measure from computed tomography images, the images containing voxels representing x-ray attenuation of a subject's heart, the method comprising:

acquiring at least one image ~~which~~ that includes the heart;

identifying a region of the heart or blood in the image;

determining a CT ~~number~~ attenuation measure of at least one voxel in the heart or blood region;

identifying at least one region ~~which contains~~ that represents calcium in the image;

determining a CT ~~number~~ attenuation measure of the calcium; and

correcting ~~at least one image of the heart~~ the at least one region that represents calcium using a relationship between the heart CT ~~number~~ attenuation measure of the heart or blood and a reference CT attenuation measure of heart or blood;

~~establishing a calcium CT number threshold which is greater than the heart CT number measure; and~~

~~determining a calcium measure.~~

11. (Currently Amended) The method of Claim 10₁ wherein the region of the heart or blood comprises is the entire heart.

12. (Currently Amended) The method of Claim 10₁ wherein the CT ~~number~~ attenuation measure of the blood or heart region is the mode of a histogram of the CT attenuation numbers.

13. (Currently Amended) The method of Claim 10₁ ~~wherein the correcting means applies~~ further comprising applying a smoothing algorithm ~~which that~~ produces CT ~~slices an image with a mode and of a CT attenuation histogram distribution equal to the heart reference CT number attenuation measure.~~

14. (Currently Amended) The method of Claim 10₁ wherein the CT ~~number~~ attenuation measure of the blood or heart region is ~~the~~ a CT attenuation number of a voxel.

15. (Currently Amended) A method of ~~determining tissue densities from calibrating a~~ computed tomography (CT) image based on vivo tissue density, ~~the images containing voxels representing x-ray attenuation of a subject's body, the method comprising:~~

~~acquiring at least one~~ a CT image of the subject's body;

~~segmenting a region of the image containing~~ representing a reference tissue of the subject's body;

~~determining a CT~~ density measure of at least one voxel represented in the ~~region containing reference tissue~~ region;

~~correcting the image using at least one~~ based on the CT density measure of the reference tissue; and

~~recording the corrected image.~~

16. (Currently Amended) The method of Claim 15₁ wherein the reference tissue is subcutaneous fat.

17. (Currently Amended) The method of Claim 15₁ wherein the reference tissue is air.

18. (Currently Amended) The method of Claim 17, wherein the air is air internal to the body.

19. (Currently Amended) The method of Claim 15, wherein the determining step comprises performing a histogram analysis of ~~all~~ voxels after segmentation of the region.

20. (Currently Amended) A method to quantify calcium in ~~the arteries~~ an artery of a human subjects ~~from at least one~~ represented in a computed tomography (CT) image, the method comprising:

scanning a reference calibration phantom containing calcium ~~simultaneously with the subject~~;

calibrating at least one image pixel using the calibration phantom;

locating the boundaries of blood or the heart;

determining a CT ~~number~~ attenuation measure of voxels within the boundaries;

determining a calibration equation ~~which~~ that includes a slope of CT attenuation numbers in the calibration phantom and ~~which~~ that includes an intercept determined from the CT ~~number~~ attenuation measure of voxels within the boundaries;

correcting pixels within the image by the calibration equation; and

identifying voxels above a threshold value; ~~and determining to detect~~ calcium within the ~~arteries~~ artery.

21. (Currently Amended) The method of Claim 20, wherein the ~~arteries are~~ the artery is a coronary arteries artery.

22. (Currently Amended) The method of Claim 20, wherein the locating boundaries step uses an edge threshold value ~~which~~ that is calibrated.

23. (Currently Amended) The method of Claim 20, wherein the boundaries are ~~the~~ three-dimensional borders of the heart.

24. (Currently Amended) The method of Claim 20, wherein the ~~best~~ CT attenuation measure is the mode of the a histogram of the CT attenuation numbers.

25. (Currently Amended) A method of displaying an a calibrated CT image of a subject, ~~the image containing gray scale pixel values representative of tissue properties of the subject~~, the method comprising:

imaging a subject to produce an image;

imaging a known reference simultaneously with the subject material having a known property other than x-ray attenuation ;

calibrating the image of the subject by calibrating the pixel values of the image based on with pixel values of the reference material;

defining image display gray ranges of window and level for the calibrated image of the subject, which are known in units of the known reference, the display gray levels being optimized for viewing specific image details;

displaying the gray ranges of window and level in units based on the reference material; and

displaying the calibrated images of the subject with the defined display gray ranges.

26. (Currently Amended) The method of Claim 25, wherein the known reference is an external phantom.

27. (Currently Amended) The method of Claim 25, wherein the known reference is an internal tissue of the subject.

28. (Canceled)

29. (Currently Amended) The method of Claim 25, wherein the display gray scale ranges are calibrated expressed in HU values.

30. (New) The method of Claim 25, wherein the display gray ranges are expressed in density units.

31. (New) The method of Claim 30, wherein the density units comprise grams per cubic centimeter.

32. (New) The method of Claim 20, wherein the artery is the aorta of the subject.

Appl. No. : **09/989,995**
Filed : **November 21, 2001**

SUMMARY OF INTERVIEW

Exhibits and/or Demonstrations

None

Identification of Claims Discussed

Claims 1, 6, 10, 20

Identification of Prior Art Discussed

U.S. Patent No. 6,792,074 to Erbel et al.

Proposed Amendments

Applicant's attorney proposed amending at least Claims 1, 6, 10, and 20 to clarify the CT measure to be a CT x-ray attenuation measure.

Principal Arguments and Other Matters

Erbel and other cited references correct for distance and position, or for fusion of CT images with other modalities. In an embodiment, the claimed invention corrects for the density (mass per unit volume) of a tissue represented in a CT image.

Results of Interview

The Examiner suggested that Applicant's attorney submit amendments and arguments (submitted herein) for the Examiner's review in the response to the Office Action of November 2, 2004.